Frequently asked questions about Global Warming and Climate Change

The questions and answers below are taken primarily from the Union of Concerned Scientists and the Worldwatch Institute web pages. In a couple of instances more up to date information is supplied. In each case the source is identified.

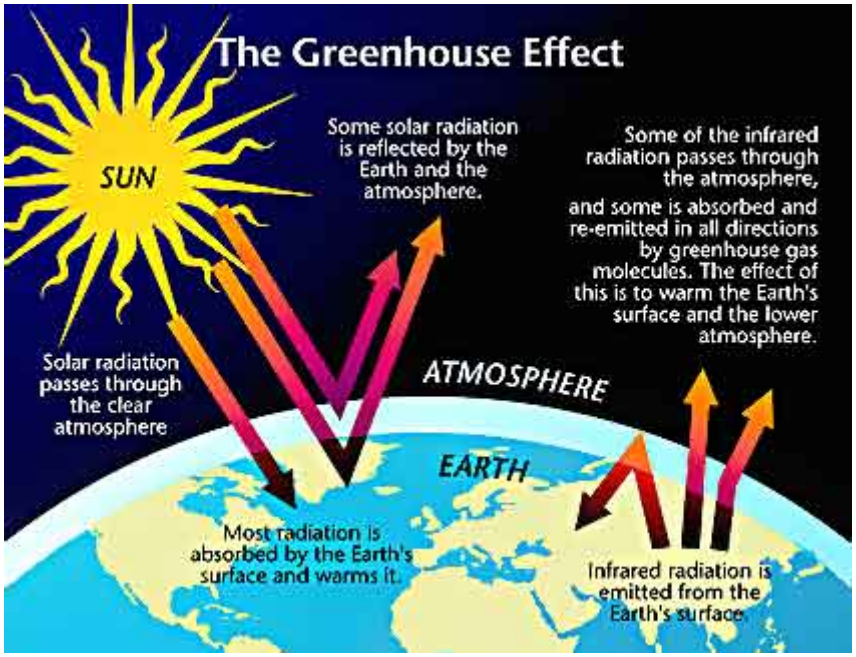
UCS indicates the source is the Union of Concerned Scientists
http://www.ucsusa.org/global_warming/science/global-warming-faq.html#1

WWI indicates the source is the Worldwatch Institute http://www.worldwatch.org.

IPCC: Intergovernmental Panel on Climate Change

TAR: Third Assessment Report, the last Climate change report from the IPCC, published in 2001.

What does the greenhouse effect have to do with global warming?



The "greenhouse effect" refers to the natural phenomenon that keeps the Earth in a temperature range that allows life to flourish. The sun's enormous energy warms the Earth's surface and its atmosphere. As this energy radiates back toward space as heat, a portion is absorbed by a delicate balance of heat-trapping gases in the atmosphere—among them carbon dioxide and methane—which creates an insulating layer. With the temperature control of the greenhouse effect, the Earth has an average surface temperature of 59°F (15°C). Without it, the average surface temperature would be 0°F (-18°C), a temperature so low that the Earth would be frozen and could not sustain life.

"Global warming" refers to the rise in the Earth's temperature resulting from an increase in heat-trapping gases in the atmosphere. ***UCS***

What are climate change and global warming, and how are they related?

Global warming refers to an increase in average global temperatures, which in turn causes climate change.

Climate change refers to changes in seasonal temperature, precipitation, wind, and humidity for a given area. Climate change can involve cooling or warming.

Temperature readings taken around the world in recent decades, and scientific studies of tree rings, corals, and ice cores, show that average global temperatures have risen since the industrial revolution began, with increases accelerating over the past few decades. The overwhelming consensus among climate scientists is that most of the increase is due to human economic activity, especially the burning of fossil fuels and deforestation. These activities contribute to a build-up in carbon dioxide (CO_2) and other gases in Earth's atmosphere.

Our atmosphere is made up of gases, such as nitrogen, oxygen, and CO_2, and water vapor, which act like a "blanket" draped around the planet. Some of these gases—such as CO_2, water vapor, and methane—absorb heat, reducing the amount that escapes to space, and increasing global temperatures. This is what is called the "greenhouse effect," and these gases are often referred to as "greenhouse gases."

Without this process, the temperature of Earth's atmosphere would average about 30 degrees Celsius (50 degrees Fahrenheit) colder than it is today, making it difficult for Earth to sustain life as we know it. However, if this blanket were to become too "thick," with too many gases trapping too much heat, Earth would be uninhabitable. In the atmosphere of Venus, for example, a buildup of carbon dioxide has led to a broiling temperature of 500 degrees Celsius. ***WWI***

What is causing global warming?

Scientists have concluded that human activities are contributing to global warming by adding large amounts of heat-trapping gases to the atmosphere. Our fossil fuel use is the main source of these gases. Every time we drive a car, use electricity from coal-fired power plants, or heat our homes with oil or natural gas, we release carbon dioxide and other heat-trapping gases into the air. The second most important source of greenhouse gases is deforestation, mainly in the tropics, and other land-use changes.

Since pre-industrial times, the atmospheric concentration of carbon dioxide has increased by 31 percent. Over the same period, atmospheric methane has risen by 151 percent, mostly from agricultural activities like growing rice and raising cattle.

As the concentration of these gases grows, more heat is trapped by the atmosphere and less escapes back into space. This increase in trapped heat changes the climate, causing altered weather patterns that can bring unusually intense precipitation or dry spells and more severe storms. ***UCS***

What is the best source of scientific information on global warming?

In 1988, the United Nations Environment Programme and the World Meteorological Organization set up the Intergovernmental Panel on Climate Change (IPCC) to examine the most current scientific information on global warming and climate change. More than 2,500 of the world's leading climate scientists, economists, and risk experts contributed to the panel's most recent report, *Climate Change 2001: The Third Assessment Report.*

Scientists from about 100 countries were involved in this new report—more than in any previous report and with greater participation from developing countries. These scientists reviewed all the published and peer-reviewed scientific information produced during the previous few years to assess what is known about the global climate, why and how it changes, what it will mean for people and the environment, and what can be done about it.

The Third Assessment Report is the most comprehensive and up-to-date evaluation of global warming. As the new benchmark, it serves as the basis for international climate negotiations. ***UCS***

Is global warming already happening?

Yes. The the IPCC concluded in its Third Assessment Report, "An increasing body of observations gives a collective picture of a warming world and other changes in the climate system." The kinds of changes already observed that create this consistent picture include the following:

Examples of observed climatic changes:

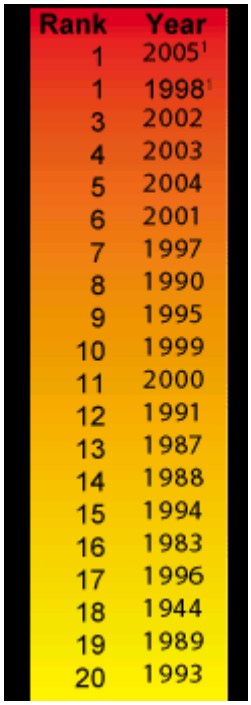
- Increase in global average surface temperature of about 1°F in the 20th century
- Decrease of snow cover and sea ice extent and the retreat of mountain glaciers in the latter half of the 20th century
- Rise in global average sea level and the increase in ocean water temperatures
- Likely increase in average precipitation over the middle and high latitudes of the Northern Hemisphere, and over tropical land areas
- Increase in the frequency of extreme precipitation events in some regions of the world

Examples of observed physical and ecological changes

- Thawing of permafrost
- Lengthening of the growing season in middle and high latitudes
- Poleward and upward shift of plant and animal ranges
- Decline of some plant and animal species
- Earlier flowering of trees
- Earlier emergence of insects
- Earlier egg-laying in birds

UCS

The Twenty Hottest Years on Record



Rank	Year
1	2005[1]
1	1998[1]
3	2002
4	2003
5	2004
6	2001
7	1997
8	1990
9	1995
10	1999
11	2000
12	1991
13	1987
14	1988
15	1994
16	1983
17	1996
18	1944
19	1989
20	1993

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Are humans contributing to global warming?

In 1995, the world's climate experts in the IPCC concluded for the first time in a cautious consensus, "The balance of evidence suggests that there is a discernible human influence on the global climate."

In its 2001 assessment, the IPCC strengthened that conclusion considerably, saying, "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities."

Scientists have found significant evidence that leads to this conclusion:

- The observed warming over the past 100 years is unlikely to be due to natural causes alone; it was unusual even in the context of the last 1,000 years.
- There are better techniques to detect climatic changes and attribute them to different causes.
- Simulations of the climate's response to natural causes (sun, volcanoes, etc.) over the latter half of the 20th century alone cannot explain the observed trends.
- Most simulation models that take into account greenhouse gas emissions and sulphate aerosols (which have a cooling effect) are consistent with observations over the last 50 years.

UCS

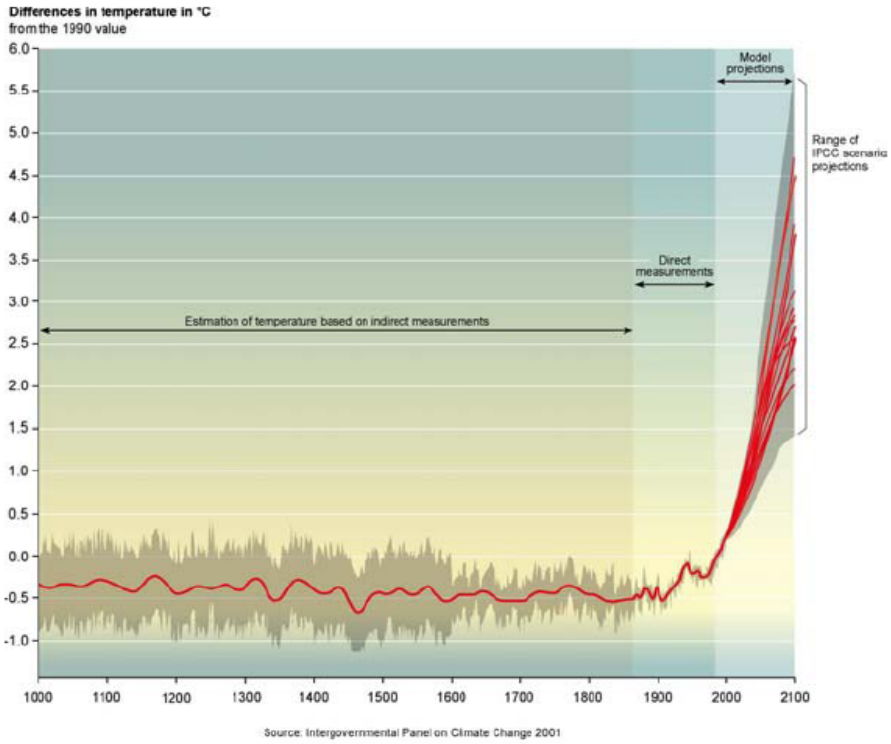
What role do natural forces play in the current global warming trend?

While some scientists continue to believe that global warming could be due to changes in sun spots, natural cycles of warming and cooling, or other factors, most scientists who study this issue now agree that it's extremely unlikely that these changes in temperature are wholly natural in origin. Instead, they believe the warming we are experiencing today is due to rising concentrations of heat-trapping gases that form a "blanket" around Earth. These gases are put into the atmosphere primarily by human activities—particularly the burning of fossil fuels. ***WWI***

How much warmer is the Earth likely to become?

The IPCC's Third Assessment Report projects that the Earth's average surface temperature will increase between 2.5° and 10.4°F (1.4°-5.8°C) between 1990 and 2100 if no major efforts are undertaken to reduce the emissions of greenhouse gases (the "business-as-usual" scenario). This is significantly higher than what the Panel predicted in 1995 (1.8°-6.3°F, or 1.0°-3.5°C), mostly because scientists expect a reduced cooling effect from tiny particles (aerosols) in the atmosphere.

Scientists predict that even if we stopped emitting heat-trapping gases immediately, the climate would not stabilize for many decades because the gases we have already released into the atmosphere will stay there for years or even centuries. So while the warming may be lower or increase at a slower rate than predicted if we reduce emissions significantly, global temperatures cannot quickly return to today's averages. And the faster and more the Earth warms, the greater the chances are for some irreversible climate changes. ***UCS***



Source: Intergovernmental Panel on Climate Change

"But if one is interested in risks and in preparing to meet them, the more interesting question is what the deep historical record can tell us about the circumstances under which climates have changed rapidly in the past and the severity of the consequences.

Considered in that way, accelerated glacial melting and larger changes in sea level (for example) should be looked at as probable events, not as hypothetical possibilities." ***Source: Editorial, Science, VOL 311 24 MARCH 2006***

" Thus, there is now perceived to be a greater risk that the upper end of the well known IPCC TAR estimate of a 1.4 to 5.8oC temperature rise will be reached or exceeded by 2100." ***Source: Stronger Evidence but New Challenges: Climate Change Science 2001-2005;Will Steffen; Executive Director of the International Geosphere-Biosphere Programme (IGBP) from 1998 through mid-2004 and, since then, as IGBP Chief Scientist and as Director of the Centre for Resource and Environmental Studies, at the Australian National University.***

What are some of the impacts we can expect from climate change?

The impacts of climate change will vary from place to place, but we can expect more severe and frequent storms (such as hurricanes and ice storms), heat waves, floods, droughts and wildfires. Warmer temperatures will increase the range of disease-bearing mosquitoes, while also increasing the range and numbers of insects and other agricultural pests, such as weeds. Melting glaciers and expanding sea water (water expands as it warms) will further raise sea level, inundating low-lying islands and flooding coastal areas, while warmer ocean temperatures will

kill many if not most of the world's coral reefs. Such events, in turn, will influence our food supply, our access to clean water, our health, and the economic and social conditions of families and communities around the world.

As ecosystems become further stressed by climate change, species extinction will accelerate. Many of the species lost will be seemingly "insignificant" plants and insects, but we will also lose plants that could cure diseases, and large animals such as polar bears, which rely on winter ice as a platform to hunt for food. Warmer winters could mean reduced snow pack for some regions, reducing water supplies and the output of hydropower dams in the northwestern U.S., for example, and shortening if not eliminating ski seasons in some regions such as New England. The regional or national economic impacts of such changes could be significant.

Many such changes are already being seen around the world. For example, the number of weather-related disasters experienced worldwide every year has been increasing over the past few decades. In the United States, the number of such disasters experienced each decade has risen fivefold since the 1970s. During the course of this century, average global surface temperatures are projected to increase at a rate unprecedented over at least the past 10,000 years, and scientists believe that rising temperatures could further increase the intensity and frequency of extreme weather events. ***WWI***

> **More recent information**:
>
> "How far can it go? The last time the world was three degrees warmer than today – which is what we expect later this century – sea levels were 25m (82ft) higher. So that is what we can look forward to if we don't act soon." ***Dr. James Hansen, Published on Friday, February 17, 2006, by the Independent/UK : Dr. James Hansen is director of the NASA Goddard Institute for Space Studies***

What is abrupt climate change

While most climate change generally happens slowly over time, there is evidence that episodes of rapid cooling have occurred in the past, with temperatures falling dramatically over periods of 10 to 20 years. Scientists have found evidence that this has happened at least twice within the past 12,700 years. ***WWI***

Could climate change ever "wipe us out"?

Past changes in climate have caused glaciers to advance and rivers to freeze. Even regional temperature fluctuations have contributed to the deaths of millions of people and the demise of civilizations, as in the cases of the Irish Potato Famine and the Vikings' departure from Greenland. But humans can move and adapt far more easily than most other species, and are unlikely to be wiped out—even by abrupt changes.

At the same time, it's important to realize that even relatively small changes in average global temperature can have significant impacts on weather patterns, agricultural productivity, water resources, and the spread of disease—and thus on millions of individual people. Climate change *will* have a lot of negative impacts, like the extinction of many plant and animal species, the

spread of disease carrying insects, more frequent and intense heat waves, floods, droughts, and wildfires. Already, the World Health Organization blames climate change for an estimated 150,000 human deaths every year. ***WWI***

Will climate change actually bring benefits to some areas?

As a result of global warming and climate change, some regions—such as Siberia—will likely become warmer and more habitable. The growing seasons in some regions will lengthen, as spring arrives earlier and winter frosts set in later.

But betting on the climate is like a game of Russian roulette. Our planet's climate is a highly complex system that we still don't fully understand. Likewise, we do not know exactly what the impacts of climate change will be on particular countries or regions. Even an area that welcomes warmer days and lighter jackets might also experience more frequent and intense storm activity, or the arrival of tropical diseases like malaria. At the same time, other places might experience problems like rising sea levels or more extreme heat or cold. And as temperatures rise and become more "comfortable" in some regions of the U.S. or Europe, for example, the number and range of agricultural pests such as insects and diseases will increase, counterbalancing benefits due to warming.

Developing countries will likely be hit hardest as warming continues because they have fewer resources with which to address and adapt to the impacts of climate change. But residents of the United States and other industrial countries will also experience negative consequences, such as increased coastal flooding and more frequent and intense heat waves, droughts, storms, and wildfires as well as the associated economic and health costs.

Most scientists believe that, at least on a global basis, the costs of climate change will far outweigh any benefits that it might bring to a given region. ***WWI***

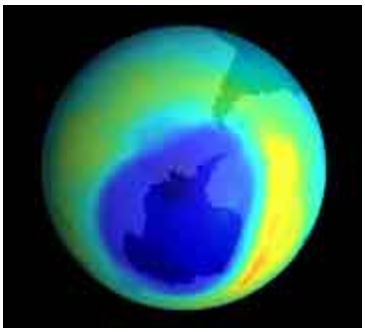
Should I be worried about climate change? Will it affect me personally?

Rising global temperature means more than just extra time to wear shorts and sandals. An increase of just a few degrees in average temperature can cause dramatic changes in conditions that are important to the quality of life—and even the Earth's ability to support life. We may not always see or feel it directly, but climate change affects us all. For one person it might mean paying more for food because flooding or drought has damaged crops. For another it might mean a higher risk of contracting a disease like malaria, which spreads more easily in warm, wet climates. Someone else might face losing her home or even life in a catastrophic weather disaster made worse by global warming.

Almost everyone is vulnerable to the effects of weather-related disasters, but people in poor countries face a far greater threat due to risk factors that include inadequate housing located on flood plains and steep hillsides, weak healthcare systems, and heavy economic dependence on agriculture. It is not uncommon for single weather events, such as tropical cyclones and floods, to kill thousands of people in regions such as South Asia, southern China, and Central America. If the warming continues for years and sea levels rise as predicted, then a great many people will

become climate refugees—because their homes and countries will be under water. Rising sea levels will also affect people in U.S. coastal regions, from the Outer Banks of North Carolina and much of Florida, to Louisiana, to California. Already, rising seas are forcing communities in Alaska to move inland, at very high cost to the state. ***WWI***

Is global warming connected to the hole in the ozone layer?



NASA image -- Ozone layer hole

Global warming and ozone depletion are two separate but related threats. Global warming and the greenhouse effect refer to the warming of the lower part of the atmosphere (also known as the troposphere) due to increasing concentrations of heat-trapping gases. By contrast, the ozone hole refers to the loss of ozone in the upper part of the atmosphere, called the stratosphere. This is of serious concern because stratospheric ozone blocks incoming ultraviolet radiation from the sun, some of which is harmful to plants, animals, and humans.

The two problems are related in a number of ways, including:

- Some human-made gases, called chlorofluorocarbons, trap heat *and* destroy the ozone layer. Currently, these gases are responsible for less than 10 percent of total atmospheric warming, far less than the contribution from the main greenhouse gas, carbon dioxide.
- The ozone layer traps heat, so if it gets destroyed, the upper atmosphere actually cools, thereby offsetting part of the warming effect of other heat-trapping gases. But that's no reason to rejoice: the cooling of the upper layers of the atmosphere can produce changes in the climate that affect weather patterns in the higher latitudes.
- Trapping heat in the lower part of the atmosphere allows less heat to escape into space and leads to cooling of the upper part of the atmosphere. The colder it gets, the greater the destruction of the protective ozone layer.

Reducing ozone-depleting gases is crucial to preventing further destruction of the ozone layer, but eliminating these gases alone will not solve the global warming problem. On the other hand, efforts to reduce all types of emissions to limit global warming will also be good for the recovery of the ozone layer. ***UCS***

Is there anything we can do about global warming?

Yes! The most important action we can take to slow global warming is to reduce emissions of heat-trapping gases. Governments, individuals, and businesses can all help.

Governments can adopt a range of options for reducing greenhouse gas emissions, including

- increasing energy efficiency standards
- encouraging the use of renewable energy sources (such as wind and solar power)
- eliminating subsidies that encourage the use of coal and oil by making them artificially cheap
- protecting and restoring forests, which serve as important storehouses of carbon

Individuals can reduce the need for fossil fuels and often save money by

- driving less and driving more fuel-efficient and less-polluting cars
- using energy-efficient appliances
- insulating homes
- using less electricity in general

Businesses can increase efficiency and save substantial sums by doing the same things on a larger scale. And utilities can avoid building expensive new power plants by encouraging and helping customers to adopt efficiency measures. ***UCS***

Which countries contribute the most to global warming?

Country	*Total emissions*	*Per capita emissions*	*Total emission*	*Growth*
	(1000 tons of C)	*(tons/capita)*	(rank)	(in %, 1990-96)
United States	1446777	5.37	-1	-9.9
Peoples Rep. of China	917997	0.76	-18	40
Russia Federation	431090	2.91	-6	-19.2 (since 1992)
Japan	318686	2.54	-9	9.1
India	272212	0.29	-20	47.7
Germany	235050	2.87	-7	-12.2
United Kingdom	152015	2.59	-8	-1.1
Canada	111723	3.76	-4	-0.1
South Korea	111370	2.46	-11	69.2
Italy	110052	1.92	-13	1.1
Ukraine	108431	2.1	-12	-37 (since 1992)
France (incl. Monaco)	98750	1.69	-15	2.4 (since 1992)
Poland	97375	2.52	-10	2.6
Mexico	95007	1.02	-17	18
Australia	83688	4.63	-2	15.3
South Africa	79898	1.88	-14	0.6
Brazil	74610	0.46	-19	34.9
Saudi Arabia	73098	3.88	-3	51.2
Iran	72779	1.04	-16	25.6
North Korea	69412	3.09	-5	4

Source: *UCS*

Wealthier industrial countries contribute the most to global warming since they use most of the world's fossil fuels. Europe, Japan, and North America—with roughly 15 percent of the world's current population—are estimated to account for two-thirds of the carbon dioxide now in the atmosphere. With less than five percent of world population, the United States is the single-largest source of carbon from fossil fuels—emitting 24 percent of the world's total. U.S. automobiles (more than 128 million, or one quarter of the world's cars) emit roughly as much carbon as the entire Japanese economy, the world's fourth-largest carbon emitter in 2000. China, despite being home to one-fifth of the world's population and its heavy dependence on coal, ranks a distant second behind the U.S., emitting 12 percent of the global total. The average person in China produces less than one-eighth as much carbon dioxide as the average American. ***WWI***

Will responding to global warming be harmful to our economy?

Reducing our impact on the global climate ***does not have to hurt*** the world's economies. The answer depends much on the "how" and "when."

The challenge is to strike a balance between responding early enough to avoid major negative (costly) impacts, and responding some time later in order to avoid taking big, expensive steps now which then may turn out to be unnecessary or inappropriate. This type of challenge is typical in business and industry; decision-making under uncertainty is the daily bread of most managers.

Clearly, global warming still involves many unknowns, but the remaining uncertainties in our scientific understanding no longer warrant a "wait and see" stance. Science tells us with increasing certainty that we are in for a serious long-term problem that will affect all of us.

And there is much we can do now that makes sense in terms of the economic bottom line while helping to reduce our impact on the global climate and on our local environment and health. The United States and other developed countries should seize the opportunity to take the lead in developing new, clean, energy-efficient technologies, and help developing countries take a greener path to economic prosperity. All of this can be done in a cost-effective manner, while creating jobs and new business opportunities.

What is the Kyoto Protocol?

International Legal Framework for Policy Action

The international policy response to climate change began with the negotiation of the United Nations Framework Convention on Climate Change (UNFCCC), opened for signature at the 1992 Earth Summit in Rio de Janeiro. The UNFCCC's "ultimate objective" is "to achieve... stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic [human-caused] interference with the climate system."

The UNFCCC has been in force since 1994 and has been ratified by Canada, the United States and virtually the entire international community. The countries that have ratified the UNFCCC (the "Parties") meet at an annual United Nations climate conference or "Conference of the Parties" where they negotiate the ongoing implementation of the convention.

The Kyoto Protocol: a Legally Binding Treaty

The UNFCCC provides a legal framework for global action to cut greenhouse gas (GHG) emissions, but it does not legally require emission reductions except in the most general way. In 1995 the Parties to the UNFCCC therefore agreed on the need for an additional treaty to set legally binding targets and timelines for the GHG emissions of industrialized countries. (The UNFCCC had called on developed countries to take the lead, noting that developing countries have much lower per-capita emissions and overriding development needs.)

The result was the negotiation, in December 1997, of the Kyoto Protocol to the UNFCCC. The protocol sets legally binding GHG emission targets for each of 38 industrialized countries, including Canada, for the period 2008-12. Taken together, the targets add up to a reduction in industrialized countries' emissions of 5% relative to the 1990 level. The protocol had been ratified by enough countries to enter into force as international law on February 16, 2005. ***Source: Pembina Institute; http://www.pembina.org/climate-change/policy-overview.php***

More questions?

If you have other questions about global warming, check out our briefings, updates, recommendations, analyses, guides, and links.

http://www.worldwatch.org

In addition, there are many web sites that answer frequently asked questions. We recommend the following:

The U.S. Environmental Protection Agency
http://yosemite.epa.gov/oar/globalwarming.nsf
/content/ClimateScienceFAQ.html

The Carbon Dioxide Information Analysis Center
http://cdiac.esd.ornl.gov/pns/faq.html

The United Nations Environment Programme/World Meteorological Organization:
http://www.gcrio.org/ipcc/qa/cover.html

The David Suzuki Foundation

http://www.davidsuzuki.org/Climate_Change/

The Pembina Institute

http://www.pembina.org/climate-change/policy-overview.php

The World Resources Institute

http://www.wri.org/

The Union of Concerned Scientists

http://www.ucsusa.org/global_warming/science/global-warming-faq.html#1

The Intergovernmental Panel on Climate Change

http://www.unep.ch/ipcc/